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The purpose of this study was to investigate both the relationship between verbalization and shift-learning and the possible prepotent stimulus dimensions of the eighty-four 7-year-olds used as subjects. Four pairs of two-dimensional stimuli were presented to the children, for the discrimination learning task, in the following order: large black, small white; large white, small black; small black, large white; and small white, large black. The two types of initial discrimination dimensions were size (S) and brightness (B). Two types of shifts, reversal (R) and nonreversal (NR), and three types of verbalization (no verbalization, one-dimension verbalization, and two-dimension verbalization) were also used. This created 12 treatment groups into which the 84 children were divided. The scores from discrimination learning under the 12 conditions indicated that (1) the R group performed superior to the NR group, (2) the S group learned more easily than the B group, and (3) no effect was due to verbalization conditions or to interactions. (WD)

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The Effect of Verbalization of Relevant and Irrelevant Dimensions on Concept Formation*

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Research over the past years has been concerned with various aspects of concept formation. One important consideration in concept formation involves the influence of verbalization. There is some evidence that the use of verbal labels facilitates concept attainment. Previous research has indicated that both children and adults are able to discriminate more quickly when they are provided with pre-training experience in labelling the stimuli (Cantor; 1955; Dietze, 1955), and when they associate verbal labels with stimulus attributes in the training process (Spiker, 1963). Among the studies investigating the effects of verbalization on shift-learning, either during pre-training or during the learning task, one finds less conclusive results. One can find support that verbalization either has no effect, interfered, or facilitated shift-learning (Wolff, 1967a).

The Kendler verbal-mediation hypothesis has served as a major impetus for investigation of the effects of verbalization in the shift-learning process. The present investigators are particularly interested in the Kendler and Kendler (1961) study of the effects of verbalization on reversal shifts in children. 4- and 7- year old children were trained to

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give relevant and irrelevant responses during original discrimination learning. Results indicated that irrelevant verbalization significantly hindered reversal shifts at both age groups, while relevant verbalization facilitated reversal shift for the 4-year-old children only. The effects of mixed verbalization (relevant and irrelevant) on shift-learning has not been investigated by the Kendlers.

It has been hypothesized that language makes stimuli more noticeable and as a mediating response serves to orient one toward a particular stimulus dimension. We have further hypothesized that if a verbal response was lengthened during initial learning to include the second dimension of a two dimension discrimination task, this new verbalization would direct attention to both the criterial dimension being reinforced and the irrelevant dimension. The overall affect would be facilitative during a non-reversal shift. In a recent study hypothesizing similar results, Milgram and Noce (1968) reported that mixed verbalization was more facilitative in discrimination learning than in reversal shift.

A second important consideration in concept formation involves the possibility of strong prepotent stimulus dimensions among Ss of various age groups. Smiley and Weir (1966) found that the rate of criterion attainment in discrimination and discrimination-shift learning was related to dimensional dominance. In addition, Wolff (1968) has investigated the role of dimensional preferences among young children and has found that in a transfer discrimination task involving the diminsions of size and brightness, nursery school children learn more easily when size is the relevant dimension than when the relevant dimension is brightness.

The present paper attempted to further investigate both the relationship between verbalization and shift-learning and the possible prepotent stimulus dimensions for 7-year-old children.

Method

Subjects

The Ss were 86 second-graders from the Bloomington Metropolitan Schools, Bloomington, Indiana. Thirty-eight of the children were girls, and forty-eight were boys. Two of the girls were eliminated from the experiment due to their failure to learn the initial discrimination. The Ss were randomly assigned to the various conditions without regard to sex or specific age considerations.

Apparatus

The experimental apparatus consisted of a specially-constructed plywood box 20 in. wide, 20 in. high and 10 in. deep, as represented in Fig. 1. Two 3 X 3 in. one-way

Fig. 1. Two 3 X 3 in. one-way

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Refer to Fig. 1 about here

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windows, 6 in. apart, were utilized for presenting the stimulus materials. A response button was located directly below each window.

A rotating rectangular box was mounted inside the apparatus for presenting stimulus pairs. Two square discriminanda made from construction paper were mounted on each of the four sides of this box. Each pair included all four possible stimulus attributes---small, large, black and white. The four pairs were arranged so that each stimulus attribute appeared twice in each position---right or left---during a full rotation of the box. In each pair, the large stimulus was 2 in. square and the small stimulus was one in. square.

Two 18 in., 60 watt lumaline lamps were mounted inside the apparatus to provide instant visibility of the stimulus materials. A small buzzer could be connected to either of the response buttons through the E's manipulation of a knife switch. The buzzer provided positive feedback for the S. In addition, a small response light---visible only to the E---was utilized to detect incorrect responses by the S.

Procedure

The 84 Ss were randomly assigned to one of 12 conditions. The two types of shifts were Reversal (R) and Nonreversal ($\overline{R}$), and the three verbalization conditions were No Verbalization (0V), One-dimension Verbalization (1V), and Two-dimension Verbalization (2V). The two types of initial discrimination dimensions were Size and Brightness. The study was planned so that the four possible stimulus dimensions---small, large, black and white---were equally represented across verbalization and shift conditions in both the initial and final discrimination tasks.

The children were individually tested in a small, private room. Each S was informed that he or she was about to play a game involving prizes at the end. Standard instructions were then given regarding the use of the apparatus, and each S was asked to complete two practice trials. Special emphasis was placed on the importance of making the buzzer sound in order to win. The E also informed each S about the four possible winning attributes and explained that the correct attribute might change during the game. The 0V Ss received no further instructions.

In addition to the above directions, the Ss in the 1V conditions were asked to provide one verbal label---"small," "large," "black" or "white"---which described their stimulus choice on each trial. The 2V Ss were instructed to tell both the size and color of the stimulus object which they picked to win on each trial. The Ss in both 1V and 2V conditions were asked to make their verbal response before they pressed the button under the stimulus object which they had picked to win. These Ss were also given two practice trials in order to ensure that the verbal responses would be made in the desired manner.

It should be pointed out that all Ss were informed, as part of the instructions, of the stimulus dimension (size or color) which was relevant in the initial discrimination task. This procedure was carried out in order to facilitate learning of the initial discrimination. The Ss who had difficulty in learning the original discrimination were prompted by the E to focus their attention on the relevant stimulus attributes.

The beginning of each discrimination trial was indicated when the lamps were switched on to provide illumination for the pair of stimuli. For each S, the initial starting order of the stimulus pairs was determined on a random basis. The rectangular box in the apparatus was rotated one quarter turn after each trial, and thus the stimulus pairs were presented to each S in the following continual order: LB-SW, LW-SB, SB-LW, SW-LB. For both the initial and the final discrimination tasks, the criterion was 9 out of 10 successive correct responses. The Ss who went beyond 72 trials in learning the final discrimination were considered to have learned the correct stimulus attribute at the end of 72 trials.

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Results and Discussion

Since the variances of scores varied widely between conditions, these scores were subjected to a log transformation prior to analysis. Trials to criterion in transfer learning are shown in Table 1.

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Insert Table 1 about here
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As expected, Ss in the reversal shift conditions required significantly fewer trials to criterion than those in the nonreversal conditions ($F_{(1,72)} = 12.4$, $P < .05$). The data also indicated that Ss learned more easily when size is the relevant dimension than when the relevant dimension is brightness ($F_{(1,72)} = 4.01$, $P < .05$). Contrary to expectation, analysis of variance indicated no effect due to verbalization or to interaction.

One possible explanation of the above results concerns the influence of the instructions on subsequent discrimination performance. Since all Ss were given the entire universe of potentially relevant stimulus attributes - large, small, black, and white - in the initial instructions, it may be reasoned that this information tended to reduce the differential effects of the verbalization conditions. If mediation actually consists of covert verbalization, it may be hypothesized that once the mediating child is aware of the verbal labels for potentially relevant discriminations, the overt use of such labels will not necessarily provide additional support in the mediating process.

Failure to demonstrate verbal facilitation may have also been due to methodological problems caused by confounding the verbalization conditions with R and $\overline{R}$. In one case (IVR), verbalization was within a dimension that was to become relevant during transfer learning. Previous research

has illustrated the facilitative effects of relevant verbalization. In the other condition (1VR) verbalization was in a dimension that was to become irrelevant which according to previous research should retard shift-learning. Thus, it can be argued that the two conditions would cancel each other out.

In the present design, one might expect an interaction in the 1V$\overline{R}$ condition due to the training of irrelevant verbalization. This condition should have had the greatest number of trials to criterion among the three $\overline{R}$ conditions. However, 1VR did not differ from OVR. The enteraction probably would have occurred if it was not for the differential effects of size and brightness during the verbalization conditions. The data indicated that during transfer learning, one and two dimension verbalization facilitated the acquisition of a size discrimination to a greater extent than a brightness discrimination. This distinction appeared to have cancelled out any possible interfering effects of verbalization in 1V$\overline{R}$.

As predicted, 2V required the fewest number of trials to criterion among the three verbalization conditions for both R and $\overline{R}$. As in 1V, when brightness was the criterial dimension, the ease of shift did not differ from OV. Therefore, preventing the occurrence of any interaction effect demonstrating the facilitative effects of 2V.

During discrimination learning for 1V, Ss appeared to begin by selecting a size discrimination during the initial trials. When size was the criterial dimension they appeared "unwilling" to surrender this label during $\overline{R}$ to brightness. But when brightness was the criterial dimension during discrimination learning, Ss appeared to be more willing to use a size designation once they realized that their selections were no longer correct during shift-learning.

Some evidence for this phenomenon is supported by Wolff's (1967b) findings that there is an increase in preference for the size dimension at age seven. However, Wolff did not find a corresponding increase in the emission of size labels.

If size appeared high on these Ss verbal hierarchy, it may be reasoned that size was more difficult to extinguish during R, thus affecting the ease of shift from brightness to size as compared to the shift from size to brightness.

This same condition appeared to have influenced the effect of 2V. Although Ss verbalized both dimensions simultaneously, this condition did not serve to direct equal attention to both dimensions, and perhaps causing the similarity between 1V and 2V.

The above explanation for the differential effects of size and brightness during 1V and 2V can only be speculative, since actual percentages of Ss verbalizing size and brightness during 1V was not obtained.

In future studies of this type, data concerning a)number of trials required in discrimination learning, b)frequency of Ss verbalizing size and brightness during 1V and c)Ss stimulus preferences should help explain any differential dimensional effects.

The data suggested that continued studies of the possible interactive effects of verbalization and dimensional preferences should prove to be a fruitful area of investigation.

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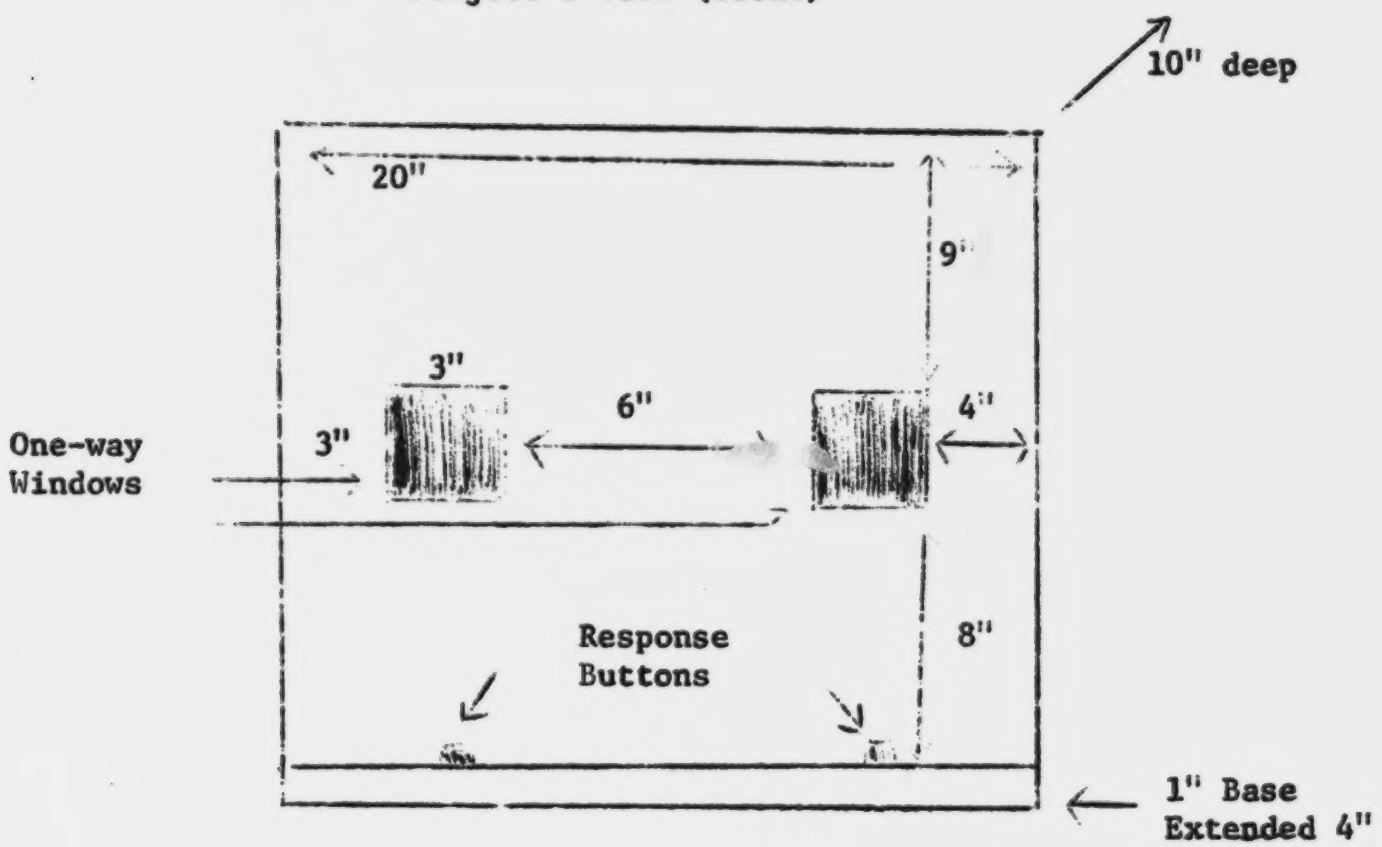
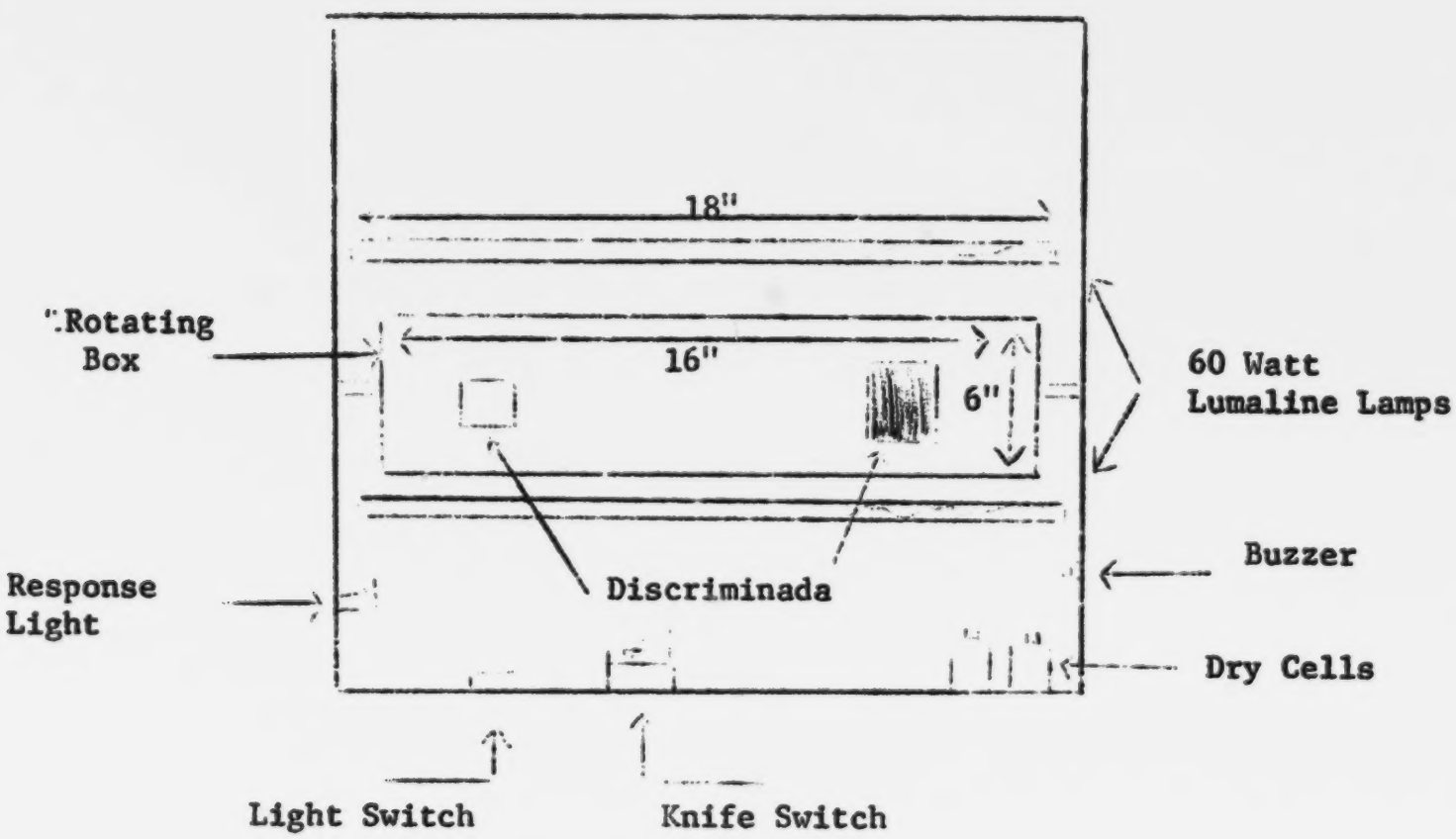
Figure I

Experimental Apparatus *

Subject's View (front)



Experimenter's View (rear)



*Not drawn to scale

Table I

Means and Standard Deviations of Trials to Criterion Scores in Transfer Learning

Type of Shift	Relevant Transfer Learning Dimension	Condition	Mean	S. D.
Reversal	Size	OV	1.263	.222
	Brightness	OV	1.269	.295
	Size	1V	1.128	.066
	Brightness	1V	1.245	.332
	Size	2V	1.094	.135
	Brightness	2V	1.225	.201
Nonreversal	Size	OV	1.427	.332
	Brightness	OV	1.405	.272
	Size	1V	1.318	.203
	Brightness	1V	1.508	.115
	Size	2V	1.234	.251
	Brightness	2V	1.445	.300